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OBSERVATIONS ON SOME MEALYBUGS (COCCINEA: PSEUDOCOCCIDAE) AND THEIR NATURAL ENEMIES ON ARBORATE PLANTS IN THE REPUBLIC OF GEORGIA.

ABSTRACT

OBSERVATIONS ON SOME MEALYBUGS (COCCINEA: PSEUDOCOCCIDAE) AND THEIR NATURAL ENEMIES ON ARBORATE PLANTS IN THE REPUBLIC OF GEORGIA.

Twenty-one species of Pseudococcidae are associated with arborate plants in Georgia. About 50% are adventive species which are mostly restricted to the subtropical zone of the Black Sea, although *Pseudococcus comstocki* (Kuwana) and *Planococcus ficus* (Signoret) are widespread, while the main pest is *Planococcus ficus*, which is injurious to grapevine and some other plants. The indigenous species are related to other European or Euro-central asian species. Three species have been described from Georgia, but native mealybugs are of no economic importance and are rarely found in urban areas. The main biocontrol agents for most of these mealybugs are encyrtid wasps (Hymenoptera: Chalcidoidea). The species described from Georgia which may be effective biocontrol agents are: *Aphycus hadzibeyliae* Trjapitzin, a parasitoid of *Phenacoccus aceris* (Signoret) and *Phenacoccus transcaucasicus* Hadzibeyli, and *Pseudaphycus phenacocci* Jasnosh, also a parasitoid of *P. aceris* (as *P. mespili* (Signoret)). A revised check-list of the mealybugs and their parasitoids in Georgia is given.

Key words: distribution, host plants, damage, natural enemies, Aphelinidae, Proctotrupoidea, Platogasteridae, Coccinellidae, Chrysopidae, Chamaemyidae, Encyrtidae, Pteromalidae, Signiphoridae, overwinter, faunistics, *Nephus*, *Chrysopa*, *Leucopis*.

INTRODUCTION

The sap-sucking scale insects (Hemiptera: Coccinea) and their natural enemies form a large component of the biodiversity of the southern Palaearctic. Many coccoid species are important pests of agriculture and horticulture and studies of these insects and the use of their natural enemies for biological control rather than using pesticides can greatly help sustainable agriculture and also benefit the environment. Faunistic, systematic and biological studies of coccoids in Georgia are mainly known from the broad investigations of Gogiberidze (1938) in the subtropical zone, and the books of Borchsenius (1949, 1963) and Hadzibeyli (1983), which have summarized other information. Other works on scale insect parasitoids and other aspects of scale biology in the Caucasus are those by Nikol'skaya & Yasnosh (1966, 1968) and Trjapitzin (1968, 1989), while similar information for Georgia can be found in Yasnosh (1967, 1972, 1995).

This review presents recent information on the distribution, host plants, damage and natural enemies of the mealybugs associated with arborate plants in Georgia. Georgia lies within the Caucasus and is divided into two regions by mountains, a humid, western, subtropical region occupying the coast of the Black Sea and neighbouring territories, and an eastern part with a drier climate. Twenty-one species of Pseudococcidae have been recorded on arborate plants in Georgia (Table 1), eight of them are adventive species, mainly found in the subtropical Black Sea coastal zone, on plants that were probably introduced when the coastal areas of ancient Kolchida were being brought under cultivation in the 19th century. Three species are found only in greenhouses but the Comstock mealybug, *Pseudococcus comstocki* (Kuwana) is widespread. The thirteen indigenous species have European or Euro-central Asian connections. Three of these species were described by Hadzibeyli and are associated with high-montain forests (e.g., *Phenacoccus montanus* on *Picea orientalis* and *Phenacoccus transcaucasicus* and *Phenacoccus gorgasalicus* on broad-leaved forest trees). The two species of *Trabutina* are restricted to the arid zone of eastern Georgia, while *P. ficus* is widespread.

Table 2 lists the 24 parasitoid species known from these mealybugs in Georgia, with 20 belonging to the superfamily Chalcidoidea and four to the Proctotrupoidea. Of these, five chalcids and two proctotrupoids have been introduced for mealybug biological control, five of which have become established and these are discussed further below. Of the rest, five are secondary parasitoids.

In addition, there are some oligophagous native predators, including *Nephus (Scymnus) bipunctatus* Kugel and *N. saturalis* Thunberg (Coleoptera: Coccinellidae); *Chrysoperla carnea* Stephan, *Chrysopa* spp. (Neuroptera, Chrysopidae), and *Leucopis alticeps* Czerny (Diptera, Chamaemyidae). Also within this complex of species are three encyrtid parasitoides of the larvae and pupae of *Nephus* sp.: *Homolotylus flaminius* (Dalman), *H. qualei* Timberlake and *Aminellus niger* Masi.

With the exception of *Planococcus ficus* (Signoret), which is a major pest in vineyards, native mealybugs are of no economic importance and are rarely, if ever, found in urban areas. The populations of species such the Maple mealybug, *Polystomophora ostiaplurima* (Kiritshenko), the polyphagous tree mealybug, *Phenacoccus aceris* (Signoret) are both primarily under the control of their natural enemies.

In 1955-56, the encyrtid parasitoid *Pseudaphycus phenacocci* Yasnosh was introduced for the control of apple mealybug in Tashkent, Uzbekistan (Central Asia) (Yasnosh, 1961). It has been found to overwinter successfully

and is a very effective biocontrol agent (Dr A. Sonina, personal communication). *P. phenacocci* is an internal parasitoid of the nymphs and adult females and has a very high reproductive potential with several generations annually, with 25-30 (occasionally more) parasitoids developing simultaneously in one female host.

Table 1: Species of Pseudococcidae recorded on arborate plants in Georgia.

Mealybug sp.	Plant genera
Heliococcus bohemicus Šulc	*Robinia, Rubus*
H. destructor Borchsenius[x]	*Morus, Punica, Robinia*
Nipaecoccus nipae (Maskell)[xx]	*Chamaerops*
Phenacoccus aceris (Signoret)	*Acer, Carpinus, Malus* and other plants
P. aceris (as *P. mespili* (Signoret)†)	*Cydonia, Fraxinus, Malus, Persica, Pyrus*
P. gorgasalicus Hadzibejli	*Malus, Pyrus, Quercus*
P. montanus (Hadzibeyli)	*Picea*
P. querculus (Borchsenius)	*Quercus*
P. transcaucasicus Hadzibeyli	*Lonicera*
Planococcus citri (Risso)[x]	*Citrus*
P. ficus (Signoret)	*Ficus, Platanus, Punica, Vitis* and other plants
P. vovae (Nasonov)	*Juniperus*
Polystomophora ostiaplurima (Kiritshenko)	*Acer*
Pseudococcus calceolariae (Maskell)[x]	*Citrus* and many other plants
P. comstocki (Kuwana)[x]	*Albizzia, Catalpa, Ficus, Morus, Punica*, many fruits and plants
P. longispinus Targioni-Tozzetti[xx]	*Trachicarpus, Citrus* and other subtropical plants
P. viburni (Signoret)[x] (= *obscurus* Essig)	*Albizzia, Citrus, Laurus, Vitis* and other plants
Ritsemia pupifera Lichtenstein	*Ulmus*
Spinococcus morissoni (Kiritshenko)	*Carpinus, Corylus*
Trabutina crassispinosa Borchsenius	*Tamarix*
T. mannipara (Hemprich & Ehrenberg)	*Tamarix*

Where: x = adventive species and xx = restricted to greenhouses. † *Phenacoccus mespili* (Signoret) was synonymised with *Phenacoccus aceris* (Signoret) by Ben-Dov & Matile-Ferrero (1995, p. 251).

Table 2: List of hymenopterous parasitoids of mealybugs on arborate plants in Georgia.

Parasitoid species	Host species
PROCTOTRUPOIDEA	
Family **Platogasteridae**	
Allotropa burelli Museback[x]	*Pseudococcus comstocki*
A. convexifrons Musebuck[x]	*P. comstocki*
A. mecrida (Walker)	*Planococcus ficus*
Allotropa sp.	*Polystomophora ostiaplurima*
CHALCIDOIDEA	
Family **Aphelinidae**	
Coccophagus gurneyi Compere[x]	*Pseudococcus calceolariae*
C. lycimnia (Walker)	*Planococcus ficus*
Marietta picta (Andre)[xx]	*Planococcus citri, P. ficus, Trabutina crassispinosa*
Family **Encyrtidae**	
Anagyrus pseudococci (Girault)	*P. ficus, P. comstocki*
A. tamaricicola Trjapitzin	*T. crassispinosa*
Aphycus apicalis (Dalman)	*Phenacoccus aceris*
A. hadzibeyliae Trjapitzin	*Phenacoccus aceris* (as *Ph. mespili*), *Phenacoccus transcaucasicus*
A. sumavicus Hoffer	*Phenacoccus montanus*
Hadzhibeylia physococci Myartseva & Trjapitzin	*Retsemia pupifera*
Leptomastidea abnormis (Girault)[x]	*P. ficus*
Leptomastix dactylopii Howard[x]	*P. ficus*
Prochiloneurus bolivari Mercet[xx]	*P. comstocki, P. ficus, P. citri*
P. pulchellus Silvestri[xx]	*T. crassispinosa*
Pseudaphycus hungaricus Erdos	*P. ostiaplurima*
P. maculipennis Mercet[x]	*P. viburni* (= *obscurus*)
P. malinus Gahan[x]	*P. comstocki*
P. phenacocci Yasnosh	*Ph. aceris* (as *Ph. mespili*)
Family **Pteromalidae**	
Eunotus sp.	*Ph. aceris*
Pachyneuron muscarum (Linnaeus)[xx]	*P. ficus*
Family **Signiphoridae**	
Chartocerus subaeneus (Förster)[xx]	*P. comstocki, P. ficus*

where: [x] =introduced for biological control and [xx] = secondary parasitoids.

Some years ago, the adventive mealybugs *Planococcus citri* Risso, *Pseudococcus comstocki* and *P. viburni* (Signoret) were pest species but, at the present time, they are of no economic importance due to the introduction of parasitoids to control them: i.e. for the citrus mealybug: *Coccophagus gurneyi* Compere; for the Comstock mealybug: *Pseudaphycus malinus* Gahan and *Allotropa* spp., and for the obscure mealybug: *Pseudaphycus*

maculipennis Mercet. All are now well established. Currently, the dominant noxious species is *P. ficus* and the coccinellid predator *Cryptolaemus montrouzieri* Mulsant has been introduced to control it (Yasnosh, 1995).

In the 1960s and 1980s, two parasitoids (*Leptomastidea abnormis* (Girault) and *Leptomastix dactylopii* Howard) were introduced to control *P. ficus* but neither was able to overwinter. However, they were found to be effective when introduced seasonally in the humid region of sea coast (Loyk & Sanaja, 1986; Yasnosh, 1995). Similarly, the coccinellid *Nephus reunioni* Fürsch, which was introduced from France, was unable to overwinter but is also recommended for control of this pest by annual introduction (Orlinsky & Izhevsky, 1987).

In conclusion, from a faunistic point of view, Georgia is of interest because it lies within the Caucasus, a transition area between Europe and Central Asia and this is reflected by the 7 species (30%) which are distributed in both these regions. Within Georgia, there are nine genera of Pseudococcidae associated with arborate plants at the present time. Two of them, namely *Phenacoccus* and *Pseudococcus*, are dominant, together comprising 50% of all known species, and their natural enemies are therefore of great importance in population control and so further parasitoid species may be recommended in the future as biocontrol agents for their control.

REFERENCES

Ben-Dov, Y., Matile-Ferrero, D., 1995 - The identity of the mealybug taxa described by V.A. Signoret (Homoptera, Coccoidea, Pseudococcidae). *Bulletin de la Société Entomologiques de France*, 100: 241-256.

Borchsenius, N.S., 1949 - Fauna of the USSR. Homoptera, VII. Nauka Press, Moskow and Leningrad. 282pp. (In Russian).

Borchsenius, N.S., 1963 - A practical key to coccids (Coccoidea) on cultural and forest plants in the USSR. Academy of Science. Moskow & Leningrad. 308pp. (In Russian).

Gogiberidze, A.A., 1938 - The Coccids of the humid subtropics of Georgian SSR. Suchumi Press. 109pp. (In Russian).

Hadzibeyli, Z.K., 1983 - The Coccids (Homoptera, Coccoidea) of the subtropical zone of the Georgian SSR. Meznіereba, Tbilisi. 291pp. (In Russian).

Loyk, N.K., Sanaja, A.E., 1986 - Biological peculiarities of using *Leptomastix* and *Leptomastidea* for the biological control of *Planococcus ficus* (Sign) on grape in Abkhasia. Pp 57-65 *in*: eds. Yasnosh, V & Mzhavanadze, A. Biological control of Fruit Crops in Georgia. Agricultural Academic Press, Tbilisi. 159pp. (In Russian).

Nikol'skaya, M.N., Yasnosh, V.A., 1966 - Aphelinids of the European part of the USSR and the Caucasus. *Opredeliteli po Faune SSR*, *Izdavaemye Zoologicheskim Institutum,* 91: 1-296. (In Russian).

Nikol'skaya, M.N., Yasnosh, V.A., 1968 - On the Aphelinid fauna of the Caucasus. *Proceedings of the All-Union Entomological Society (Leningrad)*, 52: 3-42. (In Russian).

ORLINSKY, A.D., IZHEVSKY, S.S., 1987 - Biology of *Nephus reunioni* (Coleoptera, Coccinellidae), introduced predator of mealybugs. *Zoologicheskii Zhurnal*, 66: 66-70. (In Russian).

TRJAPITZIN, V.A., 1968 - On the Encyrtid fauna of the Caucasus. *Proceedings of the All-Union Entomological Society (Leningrad)*, 52: 43-125. (In Russian).

TRJAPITZIN, V.A., 1989 - Parasitic Hymenoptera of the family Encyrtidae of the Palaearctic. Nauka Press, Leningrad Division. 487pp. (In Russian).

YASNOSH, V.A., 1961 - The colonization of beneficial insects. *Journal of Plant Protection*, 3: 31-33. (In Russian).

YASNOSH, V.A., 1967 - The Aphelinids of Georgia. *Proceedings of the Zoological Institute of Georgia, Materials on the Fauna of Georgia*, part 2. Tbilisi. Pp 27-49. (In Russian).

YASNOSH, V.A., 1972 - Chalcids (Hymenoptera, Chalcidoidea) - parasitoids of scale insects (Homoptera, Coccoidea) in the arid zone of Georgia. *Proceedings of the All-Union Entomological Society (Leningrad)*, 52: 217-247. (In Russian).

YASNOSH, V.A., 1995 - Coccids of economic importance and their control in the Republic of Georgia. *Israel Journal of Entomology*, 29: 247-251.